An Overview of Corrosion Control Metalizing

Presentation for:
National Pollution Prevention Work

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Introduction

- Corrosion occurs quickly if materials are not corrosion resistant or covered by a protective coating, Metalized coatings are used for the corrosion protection of steel in rural, industrial, marine and immersion service.

- This is certainly not a new process, but improvements in high-deposition arc spray metalizing equipment and the introduction and promotion of the process has resulted in an increased interest and demand for corrosion control thermal spray coatings.

- Aluminum, zinc, and their alloys provide both barrier and cathodic protection when applied in non-through porosity thickness.

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- When cut through exposing the substrate steel, or when applied in a through porosity thickness, these metalized coatings will retard corrosion through cathodic protection.

- The metalized coatings are typically applied by a twin-wire arc-spray system. Molten metal is pneumatically propelled with compressed air and deposited on a prepared surface.

- The U.S. Air Force employs this technology on items as diverse as general purpose bombs, maintenance stands and towers.

Alloys Normally used for Corrosion Control Metalizing

- Aluminum, zinc and their alloys are used for corrosion control metalizing. These inorganic materials do not contain volatile organic compounds that can harm the environment.

- Zinc's greater chemical activity provides greater cathodic protection than aluminum. Aluminum's lower chemical activity, adherent oxide film, and high resistance compared to zinc, provides longer term protection along with high-temperature and abrasion/wear resistance.

- The selection of metalizing alloys should be based on the service environment and the desired service life.

Surface Preparation

- Because the metalized coating is mechanically bonded to the steel substrate, surface preparation is the most critical step in metalizing.
- The steel substrate should have, at a minimum, a profile depth of 2.5 mils with a sharp angular shape.
- The surface finish should be a white metal finish for marine and immersion service and a near white finish for other service applications.

Arc-spray Metalizing Equipment

- In the arc-wire process, positive and negative consumable wires (that are insulated from each other) are fed through a drive system to meet at an intersecting point in a spray head or gun.

- A potential difference of 18 to 40 volts, applied across the intersecting wires, initiates and maintains an arc that melts the tips of the wires.

- An atomizing gas stream, usually compressed air, is directed at the arc zone, atomizing molten droplets which are then deposited as splats on the targeted substrate.

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Arc-spray Metalizing Equipment
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- The arc-spray process facilitates higher spray rates than other thermal spray processes. Factors controlling the application rate are the current rating of the power source, the wire size, air pressure and volume, and the capability of the spray system to consistently function reliably at optimum spray rate parameters (wire size/ volts-amps, air volume).

- The major components of an arc spray system are:

Wire feeder	Power source
Front-end assembly	Interconnecting cables
Electronic control box	Air Supply

Application Technique

- The specified coating thickness shall be applied in several crossing passes with each pass approximately 2-3 mils thick. The thickness is kept thin to maintain good coating tensile-bond strength. Laying down an excessively thick spray pass increases the internal stresses in the thermal spray coating and decreases the ultimate tensile-bond strength of the coating.

- The spray gun stand off distance is 6-10 inches from the substrate. When the spray head is moved farther away from the substrate, more of the metalizing material will not be applied and instead will drop off in the form of dust. An excessive spray distance will also decrease the bond strength of the coating.

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Application Technique
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- The spray gun should be perpendicular to the substrate to maintain the highest bond strengths.

- Manually applied coatings should be applied in a block pattern, typically 3 feet by 3 feet. Each spray pass should be applied parallel to and overlapping the previous pass by about 40%. Successive spray coats should be applied at right angles to the previous coat until the specified coating thickness is attained. This method is preferred to achieve the most uniform coating thickness and the best possible coating quality.

Quality Assurance Steps

- Three different types of testing are commonly conducted on corrosion control metalized coatings
- Tensile Bond Test. Measured according to ASTM D 4541 using a self aligning portable adhesion test instrument. Minimum bond values have been agreed upon by NACE, SSPC and AWS.
- Bend Test. Used as a qualitative test for proper surface preparation, equipment setup and spray parameters.
- Cut Test. Consists of a single cut 1.5 inches long through the coating to the substrate.

Conclusion

- Corrosion Control Metalized Coatings have become a world wide, cost effective solution for long term corrosion control protection of steel structures.
- No VOC’s and long term performance have become driving forces in the selection of metalized coatings for corrosion protection of steel.
- The following slides illustrate a sampling of some recent metalizing projects.

Saint Andrews Lock and Dam

The St. Andrews Lock and Dam located in Lockport, Manitoba, was metalized with 3/16" diameter 85/15 from November 1998 to May of 1999. This work was accomplished during the cold winter months under an aggressive schedule and covered 380,000 square feet of surface area with a minimum 85/15 coating of 10 mils. Clara Industrial Services, from Thunder Bay, Ontario, selected Thermion Bridgemaster Systems for this project after evaluating equipment from six manufacturers. "After narrowing its choice to two candidates, the contractor invited both manufacturers to demonstrate their equipment. The contractor based its decision on the deposition rates determined at the demonstration, the ability of the equipment to spray 3/16" (4.8mm) 85/15 zinc/aluminum wire, the size and weight of the equipment, and the weight of the gun and leads. Ultimately, the contractor purchased seven units for the project."

Riveted box beams and lattice work made this project difficult for abrasive blasting and metalizing.

The complex shapes, while difficult to physically access, were successfully metalized with seven Thermion Bridgemasters spraying 3/16" diameter 85/15.

The Indianapolis Motor Speedway Grandstand "C"

The Indianapolis Motor Speedway (IMS) is the home of the world-renowned Indianapolis 500 and the Brickyard 400. Grandstand "C" at IMS was scheduled for rehabilitation during the winter of 1996/1997. The objectives of the Indianapolis Motor Speedway Corporation, for this project, were summarized and ranked as follows:

1. Corrosion Protection
2. Minimal Disruption to the Track and Neighbors
3. Cost
4. Aesthetics

An 85/15 zinc/aluminum metalized coating along with a sealcoat of polyurethane was applied to the grandstand structure. The metalized surface area was in excess of 150,000 square feet and the coating was applied to a nominal thickness of 10 mils. Interstate Coatings, from Seattle Washington, utilized High Deposition Thermion Arc Spray Systems on this project.

Signs of a failing paint system are evident in this picture.

The coated surfaces in these pictures show no signs of corrosion after three years of service. The metalized coating will provide well over 25 years of maintenance free service on this structure.

Route 9 McNaughton Bridge over the Illinois River

The McNaughton Bridge, located in Pekin, Peoria-Tazewell Counties, Illinois, carries Route 9 traffic across the Illinois River. This project, completed in the year 2000, consisted of 103,122 square feet of zinc metalizing. Thermion Bridgemaster arc-spray systems, set up for 3/16" diameter wire, were utilized by Clara Industrial Services, of Thunder Bay, Ontario. The steel deck was water blasted to remove the original coatings, tested for chlorides, grit blasted, blanked in areas not to be coated, and then metalized with 10-12 mils of zinc. The General Contractor (Halverson Construction Co. Ltd.) then welded shear connectors, placed and tied rebar, and poured new concrete.

The deck surface was grit blasted to SSPC Sp-10.

Four Thermion Bridgemasters were utilized for this project.

Deck surface (shown in foreground) has been metalized with 10-12 mils of zinc.

Boiler Repair

This illustrates a boiler repair project accomplished late in 1999. This repair job utilized two Thermion Bridgemaster Systems set-up for 1/16" diameter metalizing wire. Due to the long tip life and non-clogging nozzles, the Thermion System offered increased productivity when compared to the enclosed nozzle system the contractor had previous experience with. Thermion has completed test work using 3/32" diameter cored wire and is now evaluating the use of 1/8" diameter cored wire.

Wide angle view of spraying in progress.

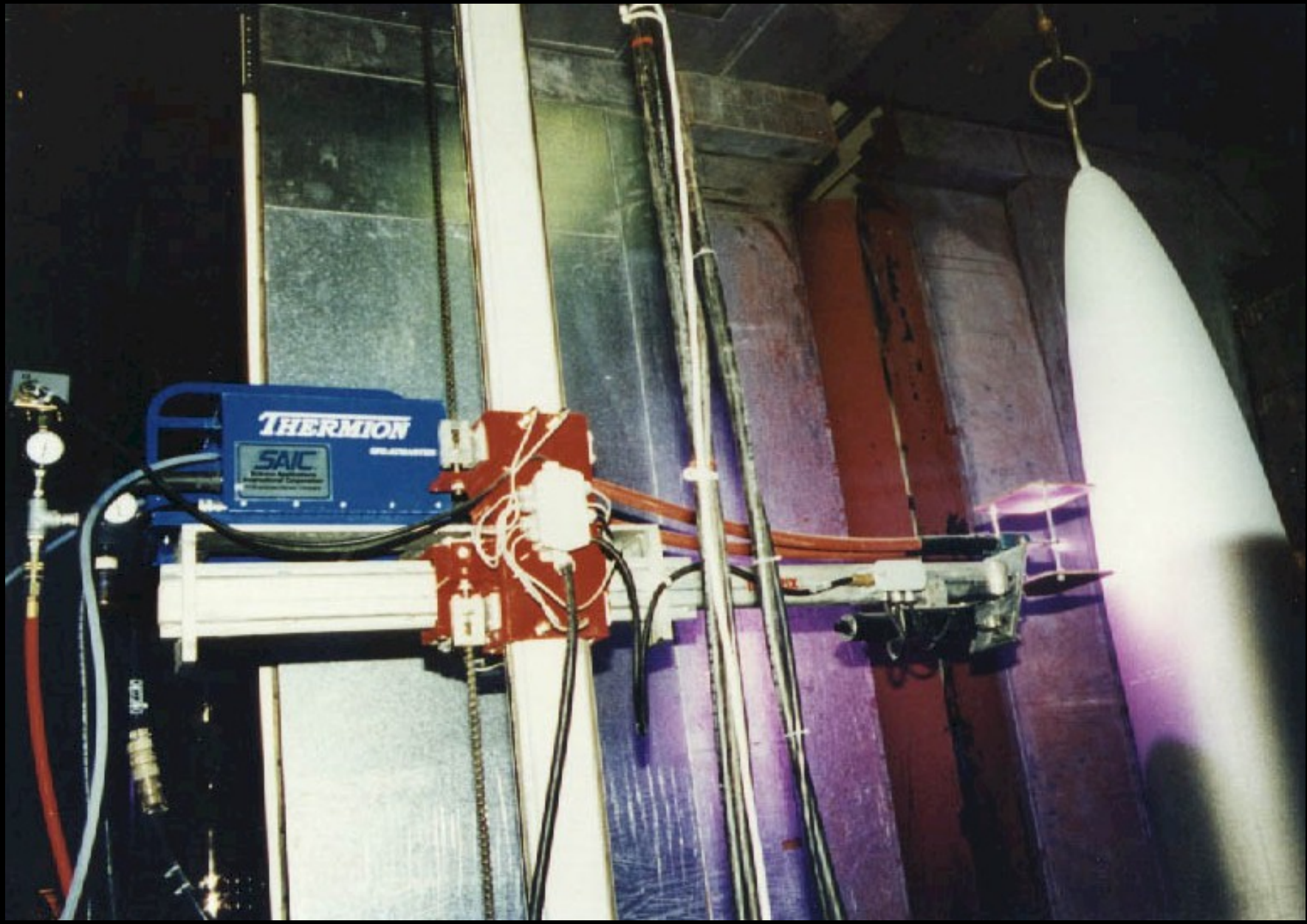
The Thermion Bridgemaster setup for 1/16" or 3/32" wire.

Burlington Skyway Bridge over Hamilton Bay in Ontario Canada

The Burlington Skyway Bridge, located southwest of Toronto, on the western end of Lake Ontario, received a metalized zinc cathodic protection system on its concrete piers in 1999. The Ontario Ministry of Transportation was pleased with both the application quality and the production schedule maintained on this project. The work entailed approximately 50,000 square feet of zinc metalizing that was applied to a minimum thickness of 12 mils. Harrison Muir Incorporated of Ajax, Ontario Canada accomplished this project working from August to December of 1999. 3/16" diameter zinc metalizing wire was sprayed by three Thermion Bridgemaster Systems. Jack Mills of Harrison Muir said he was very pleased with the over all performance of his Thermion Bridgemaster Systems and looks forward to his next metalizing project.

On the job site, Harrison Muir employees quickly mastered the Thermion Bridgemaster Arc Spray System.

Prior to accomplishing the Burlington Skyway Bridge, Harrison Muir involved many of their people in a Metalizing Equipment Training and Indoctrination Class led by Thermion personnel.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CSI COATINGS, NISKU, ALBERTA
ARC-SPRAYED 3/16" ALUMINUM

STEEL BRIDGE, GREAT BRITAIN
ARC-SPRAYED 3/16" ALUMINUM

Rainbow Bridge
Niagara Falls

85/15 Metalizing Project
2002-2003

Rainbow Bridge
Niagara Falls

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